Attractiveness, Trade Policy and Globalization: Additional Scenarios

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Introduction

This *Focus* provides additional simulations, detail and information, complementary to the *Note du CAE* no 58.[2] As it is the case for the *Note*, this Focus builds on the work and the quantitative model by Head and Mayer (2019).[3]

## 1. Model, data and calibration

1.1. The model

The model is described in full details in Head and Mayer (2019). The model is a double CES model of multinational production. In this model, a firm from a given headquarter country develops a range of car models and decides in which of its existing plants to assemble each of these car models in order to finally sell the cars in the country of the final consumer. The model therefore helps to understand the strategic sourcing choices of multinationals. These choices will depend on a set of parameters and frictions. Based on the location of the headquarters, firms optimally choose where to source the car assembly in order to reduce the coordination costs. On the other hand, production plants should not be located too far away from the final market in order to reduce the trade costs (tariffs, transportation…). Lastly, firms face marketing costs which increase with distance between headquarters and the final market as Figure 1 illustrates.

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(1) Respectively: Sciences Po; Conseil d'analyse économique (CAE); University of British Columbia, Sauder School Business; Sciences Po and CAE; Sciences Po and CAE.

(2) Head K., P. Martin and T. Mayer (2020): "Car Wars: Competitiveness, Trade and the Geography of Car Production ", *Note du CAE*, no 58, July.

(3) Head K. and T. Mayer (2019): "Brands in Motion: How Frictions Shape Multinational Production", *American Economic Review*, vol. 109, no 9, pp. 1-52.

Figure 1. Illustration of the model (multinational frictions in the model)
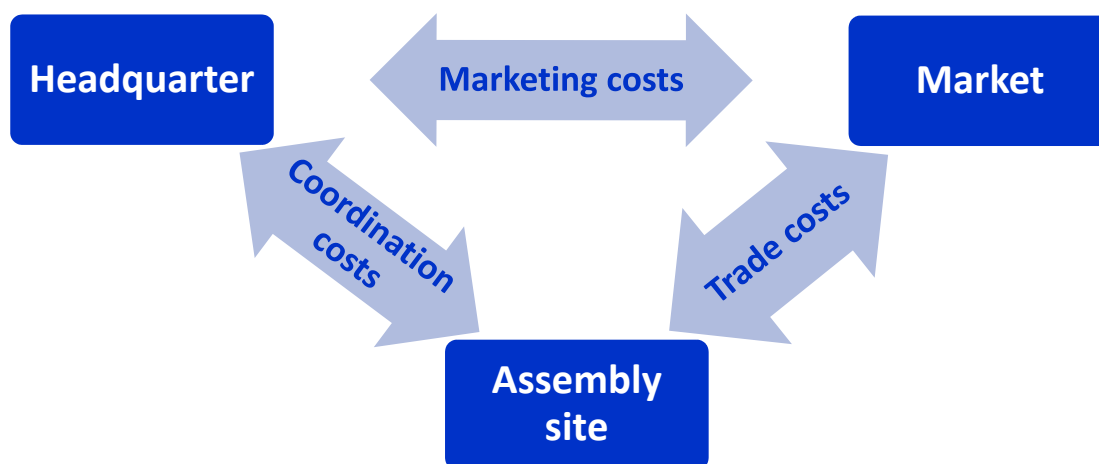
Source: Head and Mayer (2019).

The determinants for the sourcing decision can be split into two categories: the country-pair frictions (coordination costs, trade costs and marketing costs) described above and the country-specific characteristics related to production costs. Countries are more likely to be selected as country of production if they are able to offer low production costs, either through low labor costs or a high level of country-specific productivity. Moreover, the automobile industry is characterized by increasing returns to scale which pushes towards more agglomeration of production plants. Other things equal, a firm will more likely locate its production plant in a country where other plants are already operating.

The degree to which firms can adjust their sourcing choices and pricing decisions depends on two elasticizes. The first elasticity (CES parameter θ) represents the substitutability between the different plants available for a firm as a source for its car models. The large is θ, the more firms will adjust the location of the assembly site after a cost shock (on tariffs or wages for instance). The second elasticity η indicates how substitutable are brands for the consumer. It also drives firms' market power. Each firm operates under monopolistic competition, being the only producer and seller of the varieties it owns, but facing competition from other brands that consumers can buy from. This "monopolistic competition" framework gives rise to a constant mark-up set by firms over the marginal cost. This mark-up is directly driven by the η parameter.

The frictions, the countries characteristics as well as the elasticities described above are estimated based on the observed choices of the multinational firms and then used to run policy scenarios.

1.2. The data

The data comes from the consultancy firm IHS Markit. The data provides information on the location of production and the destination of the produced car at the brand and model level around the world. The data runs from 2000 to 2018 and contains 113 different brands owned by 55 parent firms and 2153 models. For each brand, the model considers the headquarter country to be the country in which the brand was founded.

The model is then confronted to the data in order to recover the structural parameters of interest. Four equations are used to estimate the parameters. The τ (trade cost) and γ (coordination) frictions are estimated thanks to the sourcing equation. The δ (marketing) frictions are estimated thanks to the market shares equation. Finally, the paper estimates two entry decisions: whether or not to offer a given model in each country and whether or not to offer the brand at all in the country.

After estimation the structural parameters are used to run counterfactuals using Exact-Hat-Algebra (EHA) (see Dekle, Eaton, Kortum, 2011)[4]. This method of running counterfactuals uses the current level of the key flows in the model, and combines it with estimated parameters to predict the percent change of all relevant outcomes of a policy experiment. Its main advantage is to be extremely economical in terms of needed parameters, and also to replicate the true data in the absence of a policy change. Its main drawbacks are its inability to handle the discrete brand entry decisions and to predict that a brand starts to use a factory for a given market if that plant was not used before the shock.

2. Attractiveness for each country

As mentioned above, countries' attractiveness depends on the country-specific production costs but also on the pre-existing plants in each country. This second effect comes from the increasing return to scale of the automotive sector. Figure 2 displays the respective contributions of the scale effect and the unite labor costs part on the cost competitiveness of various producing countries compared to France. For instance, the attractiveness of the USA is slightly better than the French one over the period, but it mainly comes from the size of the US industry allowing for scale economies rather than from lower productions costs.

France is by construction in the middle of the distribution. It should however be noted that this graph uses data from 2000 to 2018. Since 2000 France has continuously lost production, the picture would be much bleaker (mostly regarding the economies of scale part if we were to focus on the recent years.

### Figure 2. Decomposition of attractiveness (2000-2018)
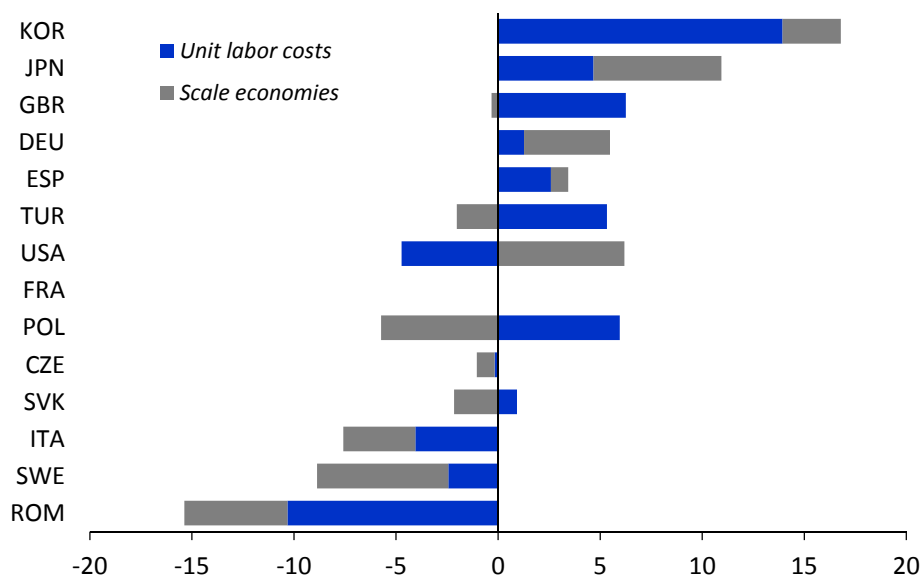
Source: Simulation by authors, IHS Markit.

2.1. Effect of the French cost decrease on other countries

In Head, Martin and Mayer (2020) *op. cit.*, we see that France would gain in terms of production after a unilateral cost decrease. In the case of a 20% cost decrease, France would increase production by 98%. However, as the model maintains world sales and production constant, what France gains in terms of production, other countries have to lose.

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(4) Dekle R., J. Eaton and S. Kortum (2011): "Global Relancing with Gravity: Measuring the Burden of Adjustment", *IMF Staff Paper*, vol. 55, no 3.

Figure 3. Production after a 20% French cost decrease

Effect on production
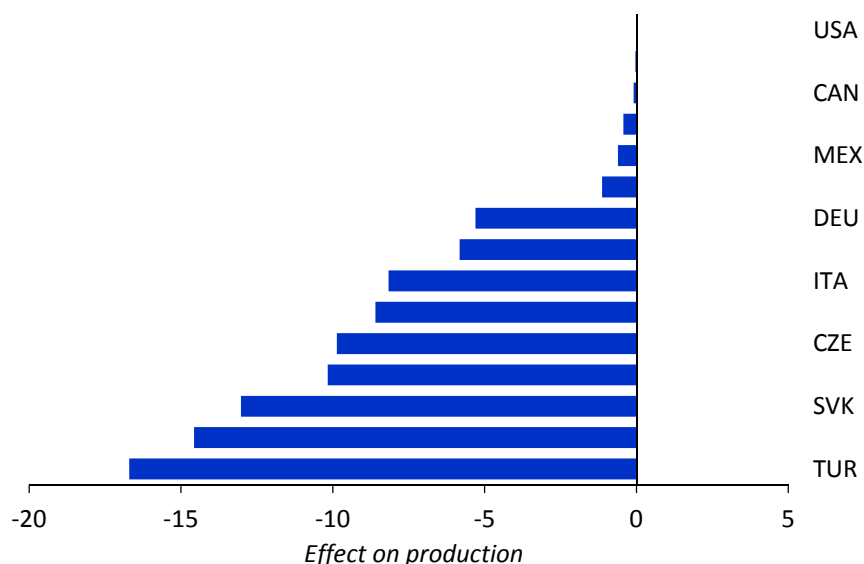
Source: Simulation by authors, IHS Markit.

2.2. Who loses from France's gains?

Besides from a few exceptions, the countries that lose the most in terms of output are European or neighboring countries where brands that are active in France also have factories. Spain and Turkey (Renault, Opel and Toyota have factories in Turkey and Renault, Opel and PSA assemble in Spain) lose the most. Eastern European countries such as Slovakia (PSA), the Czech Republic (PSA, Toyota) and Romania (Renault) also lose a significant part of production. Besides from Toyota, the changes probably come from French brands re-locating in France previously offshored production.

Germany only loses around 5% of production. Indeed, few brands (only Opel) produce cars in both countries.

The effect on the UK is more important (– 10%) as the UK is more directly in competition with France for production (Nissan, Opel, Toyota).

3. Trades wars and peace: additional results

Turning to the bilateral frictions, the model allows for counterfactual analysis of the impact of changes in the frictions on the production choices of multinational firms. For instance, tariff increase on the car industry increase the trade costs. This section provides additional results concerning the trade wars and peace scenarios.

3.1. Effects on production

Figures 4 to 9 show the production gains and losses for US, France, Germany and other countries for various scenarios. For the case of the section 232 scenarios under which the USA protect their car industry, retaliation reduces mercantilist US gains slightly. Applying tariffs to parts reduces those gains even more (German and Japanese brands located in the US would be hurt).

Japan would naturally gain in case of section 232 imposed on the EU, but would be losing large shares of production if impacted by the tariffs itself (this is natural since Japanese brands could very easily turn to their US-based plants). The gains related to Brexit are present but modest; specially compared to the scenarios of trade integration. Besides from EU-Japan and CETA agreements, the impact of all scenarios is quite similar for Korea and Japan.

Italy stands to lose a great amount from tariff wars: This comes mostly from large Jeep exports to the USA (around 100,000 cars, out of total output of 660,000 in 2018). Italian production is hurt even more by retaliation, since this raises costs of US-made inputs and lowers sales on third markets. As a natural consequence, the signature of TTIP would bring extremely large benefits to Italian production.
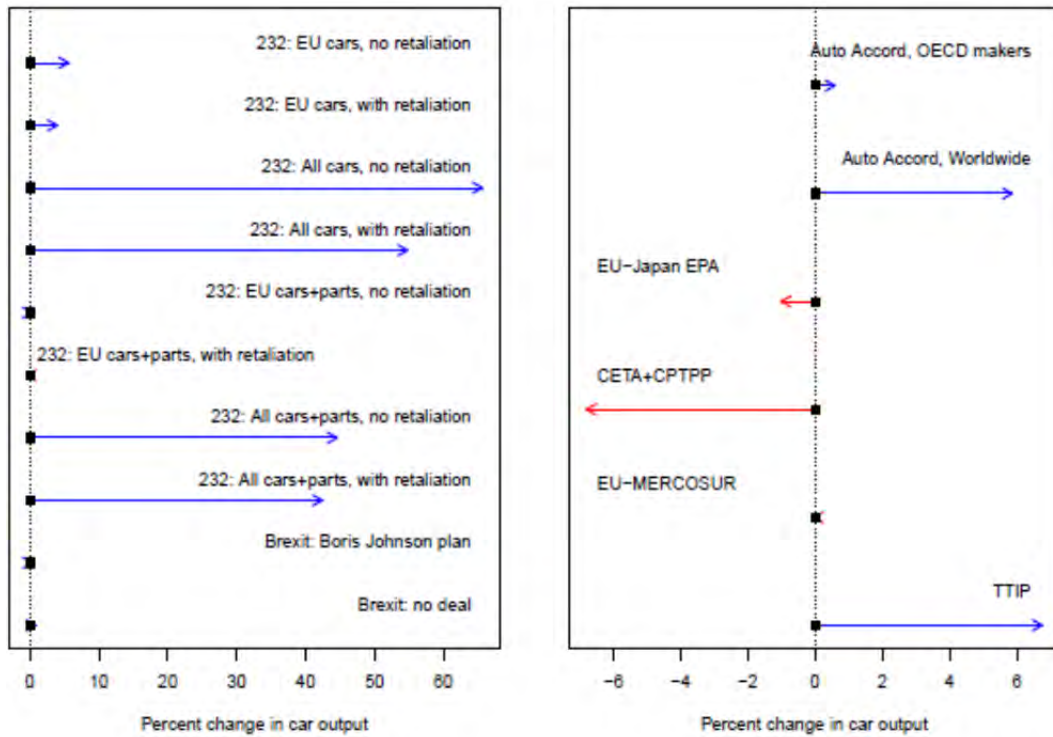
Figure 4. Impact on output for France
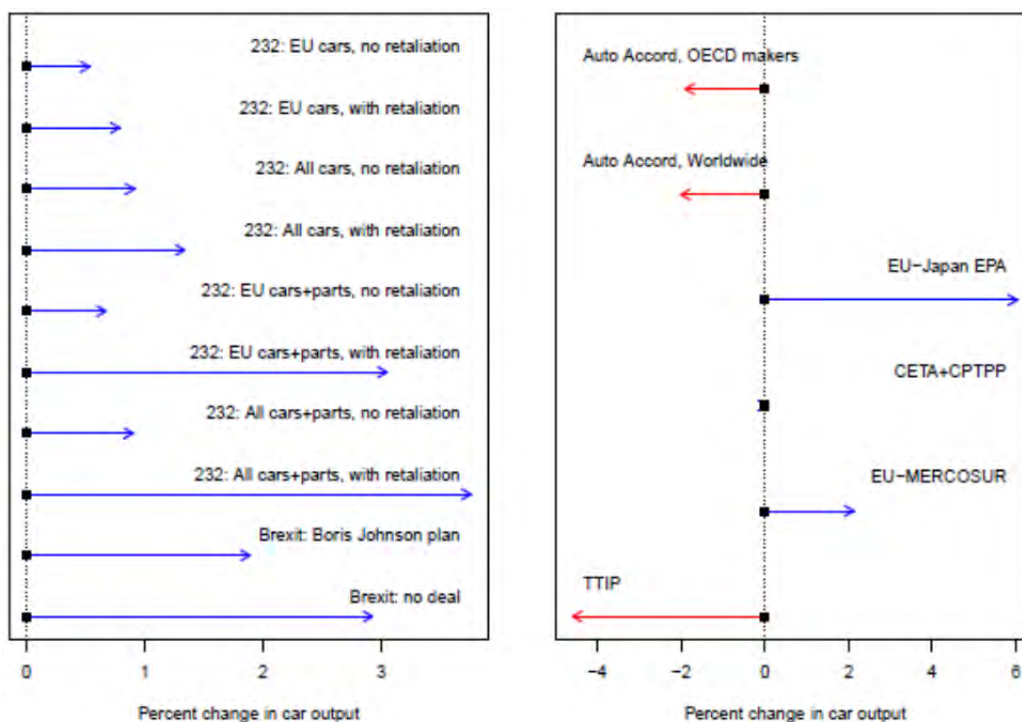
Source: Simulation by authors, IHS Markit.

Figure 5. Impact on output for Germany
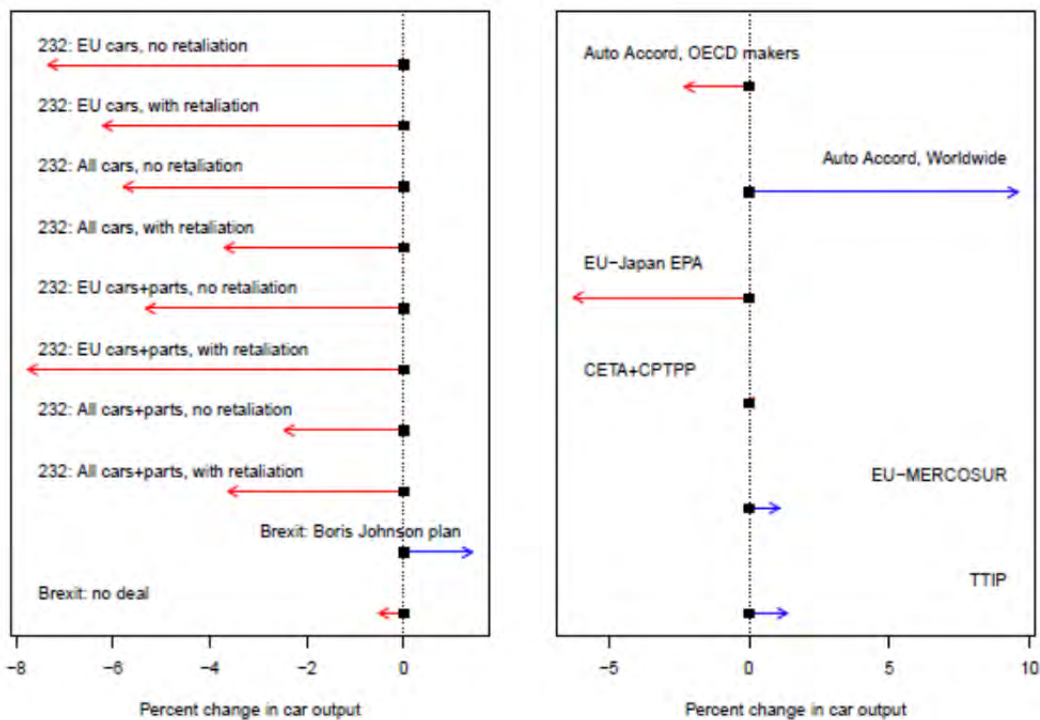
Source: Simulation by authors, IHS Markit.

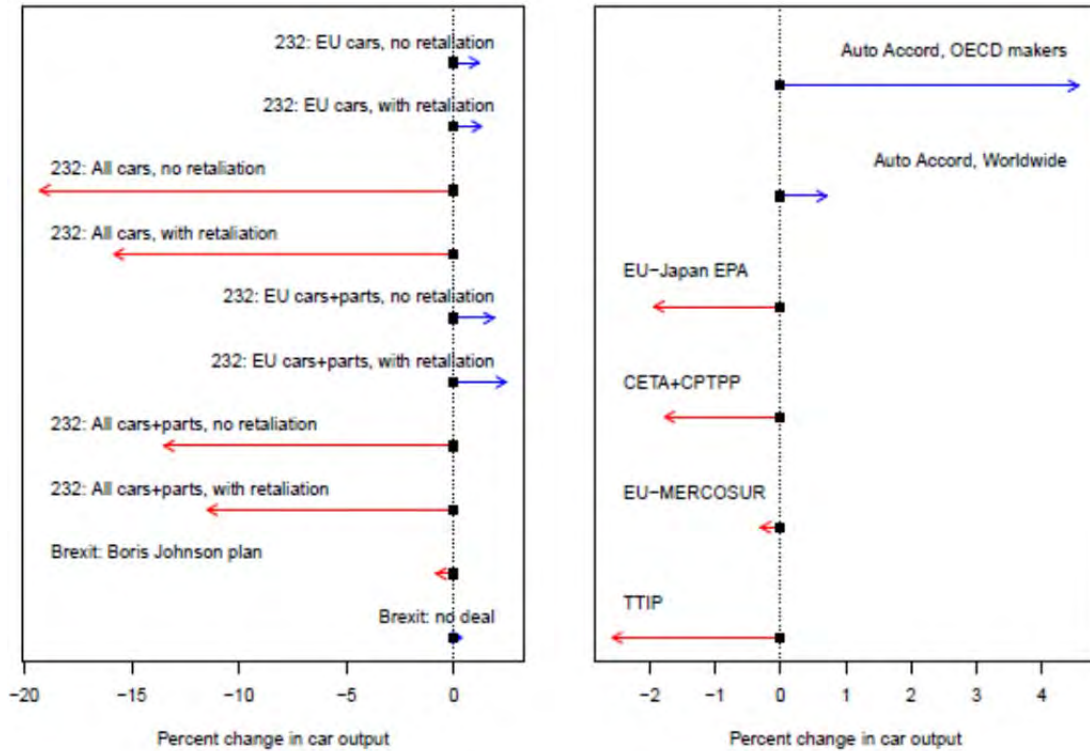## Figure 6. Impact on output for the United States

Source: Simulation by authors, IHS Markit.
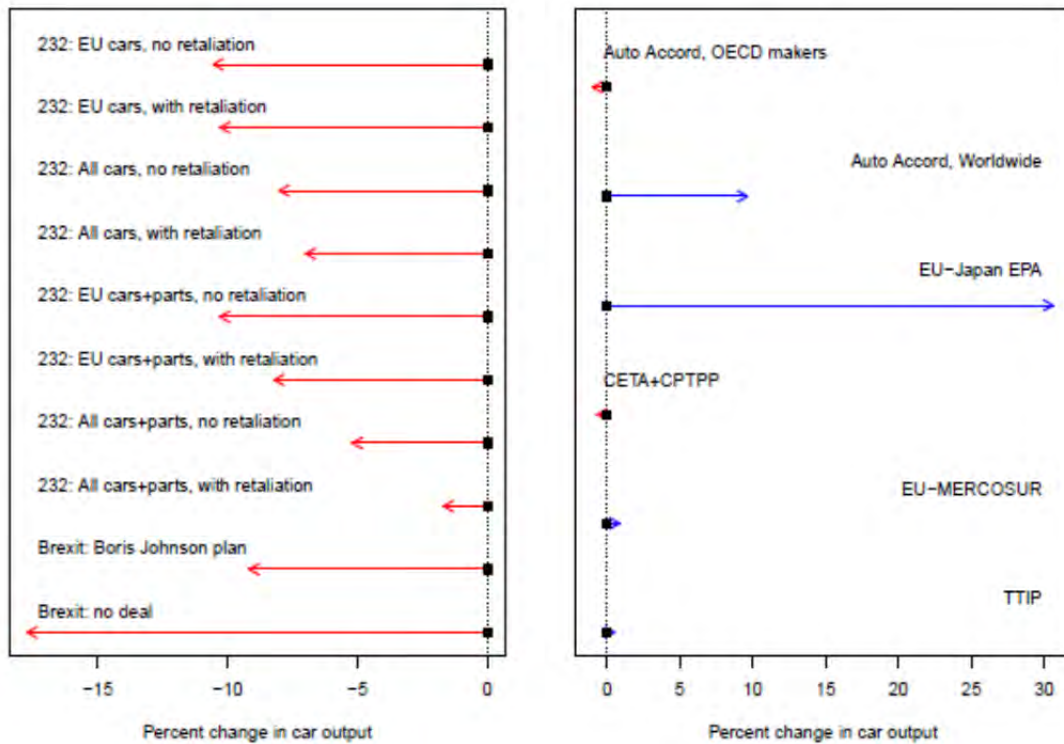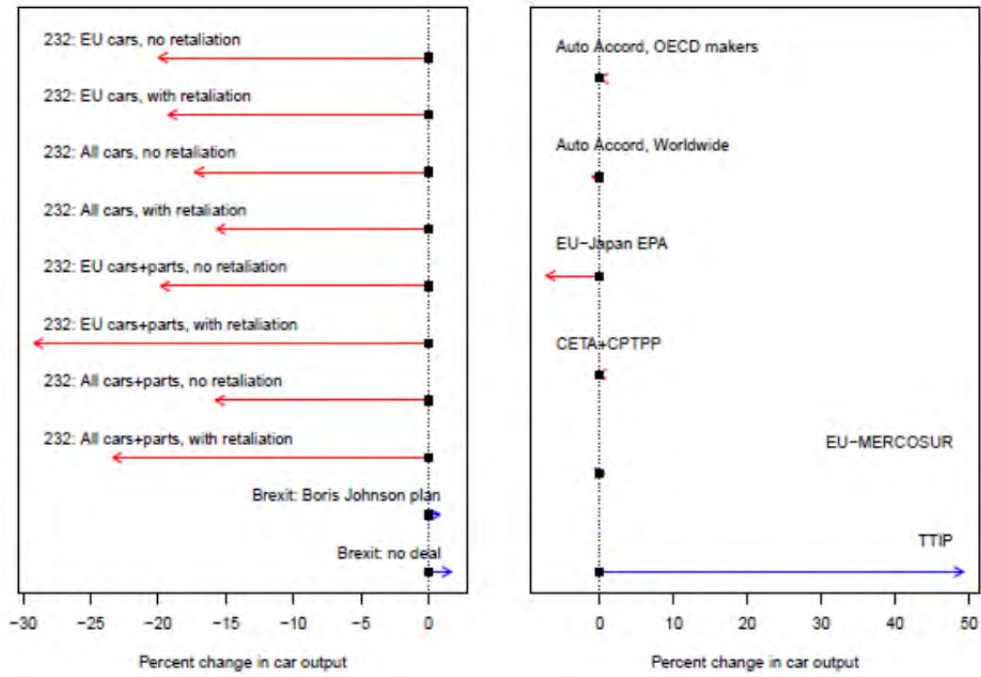
Figure 7. Impact on output for Japan

Source: Simulation by authors, IHS Markit.

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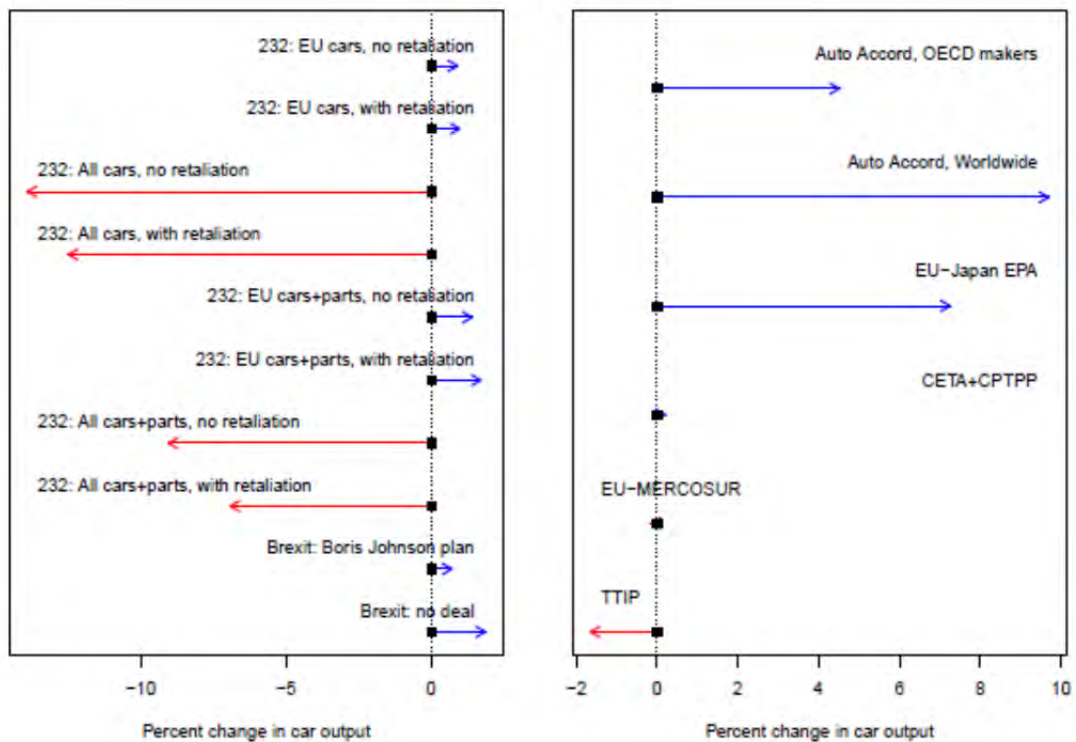
Figure 8. Impact on output for Korea

Source: Simulation by authors, IHS Markit.

8. Impact on output for Great Britain

Source: Simulation by authors, IHS Markit.

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économique

Figure 9. Impact on output for Italy

Source: Simulation by authors, IHS Markit.

3.2. Effects on consumer surplus

In most cases, the changes in consumer surplus from all scenarios are quite limited (the absolute value of the effect is rarely above 1%). In general, retaliation in the section 232 scenarios reinforces the negative effects, especially for the European countries. It is however the opposite for Japan. The negative impacts are particularly strong for the USA, the consumer surplus could decrease up to 10% in case of a trade wars on cars and cars parts. The EU-Japan agreement is by far the most beneficial to Japanese and European customers. On the other hand, the US consumer gains more from the CETA.

Figure 10. France: Percent change in consumer surplus
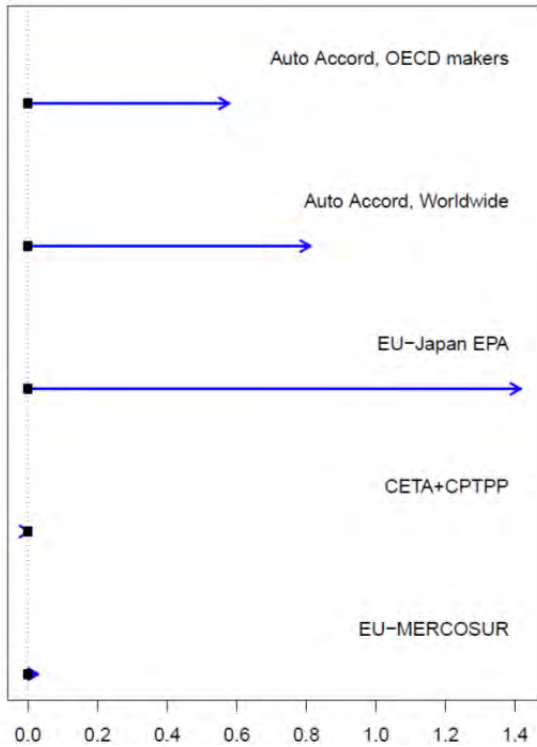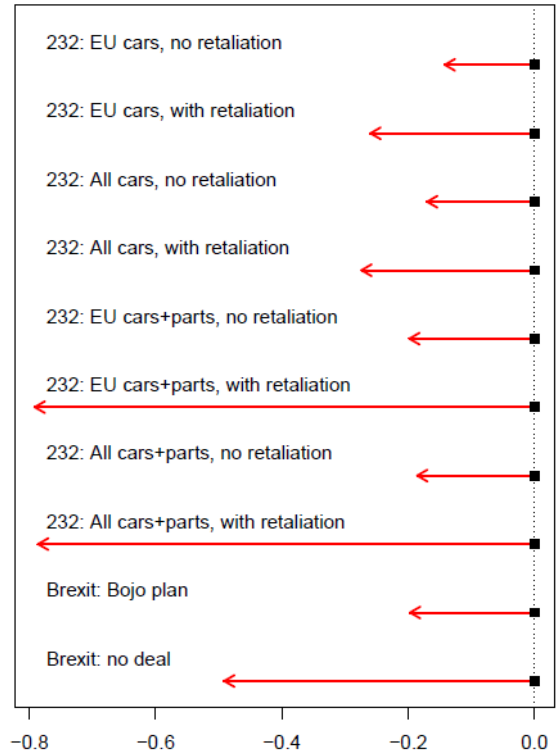
a. France peace
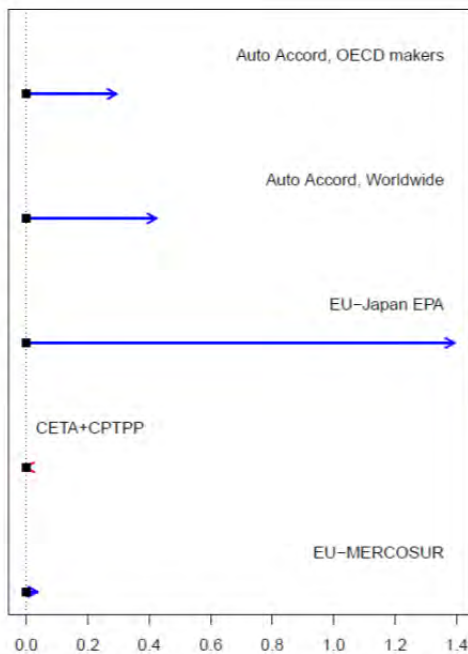
b. France war
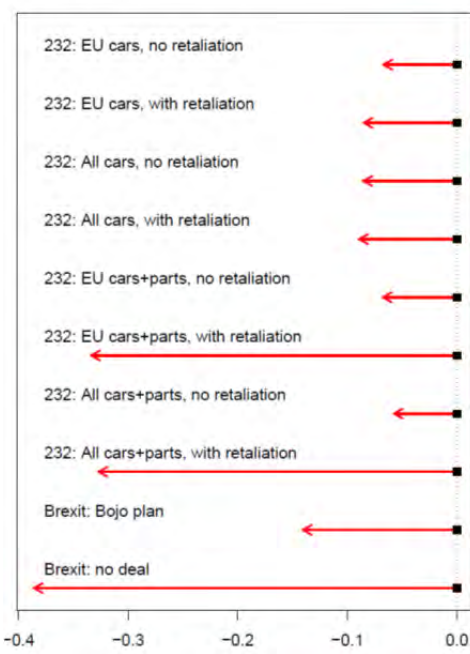
Source: Simulation by authors, IHS Markit.

Figure 11. Germany: Percent change in consumer surplus
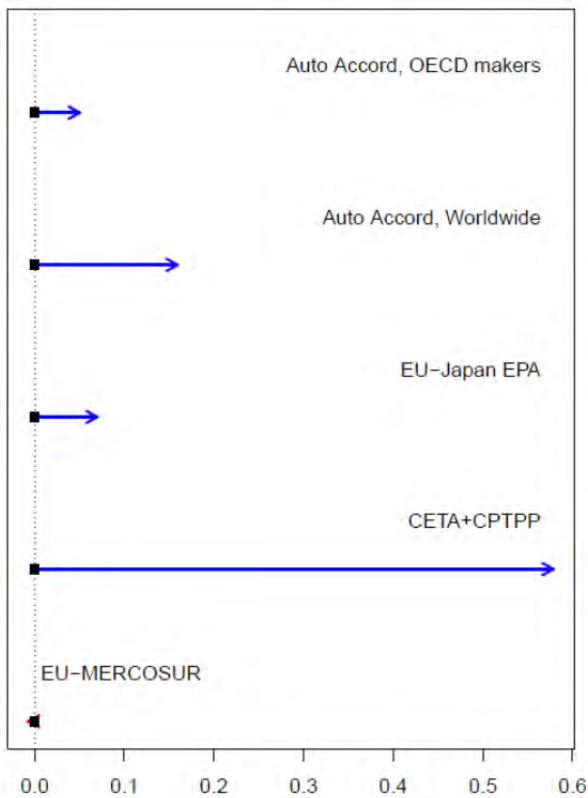
a. Germany peace

b. Germany war

Source: Simulation by authors, IHS Markit.

Figure 12. USA: Percent change in consumer surplus

a. USA peace

b. USA war

Source: Simulation by authors, IHS Markit.

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Figure 13. Japan: Percent change in consumer surplus
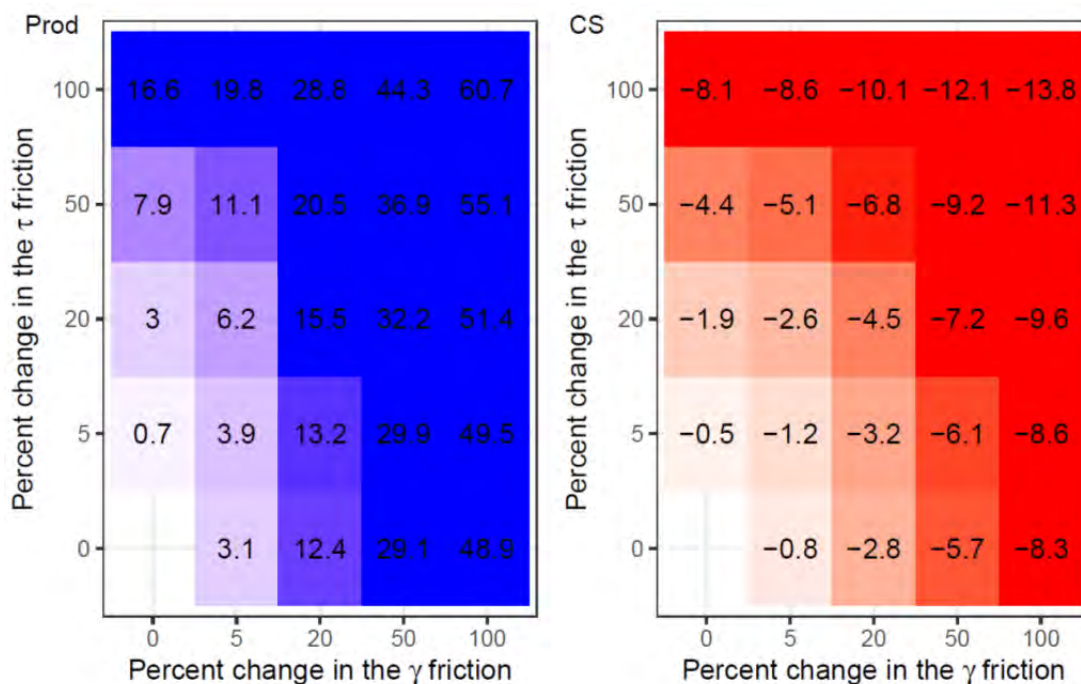
a. Japan peace
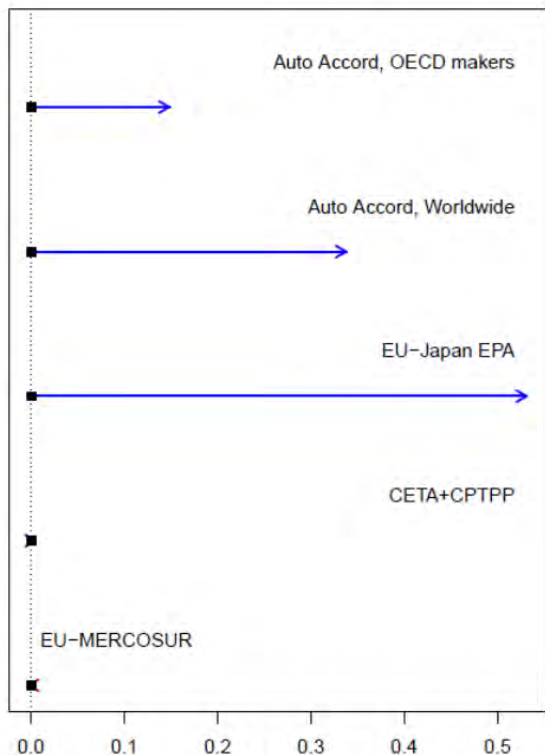
b. Japan war
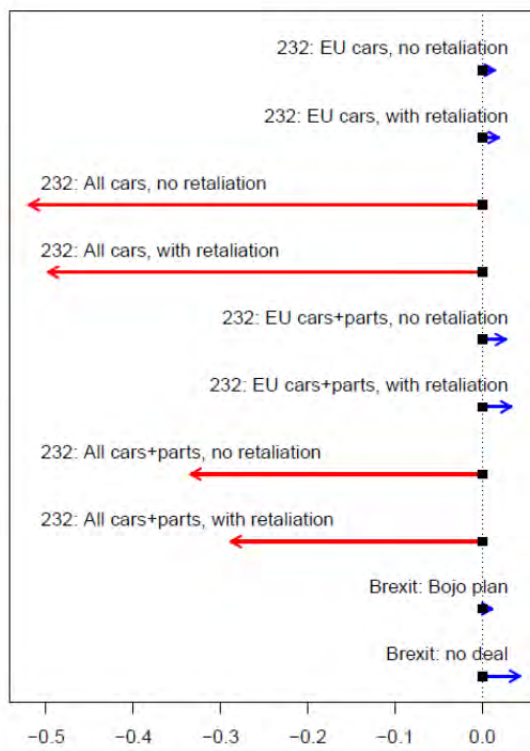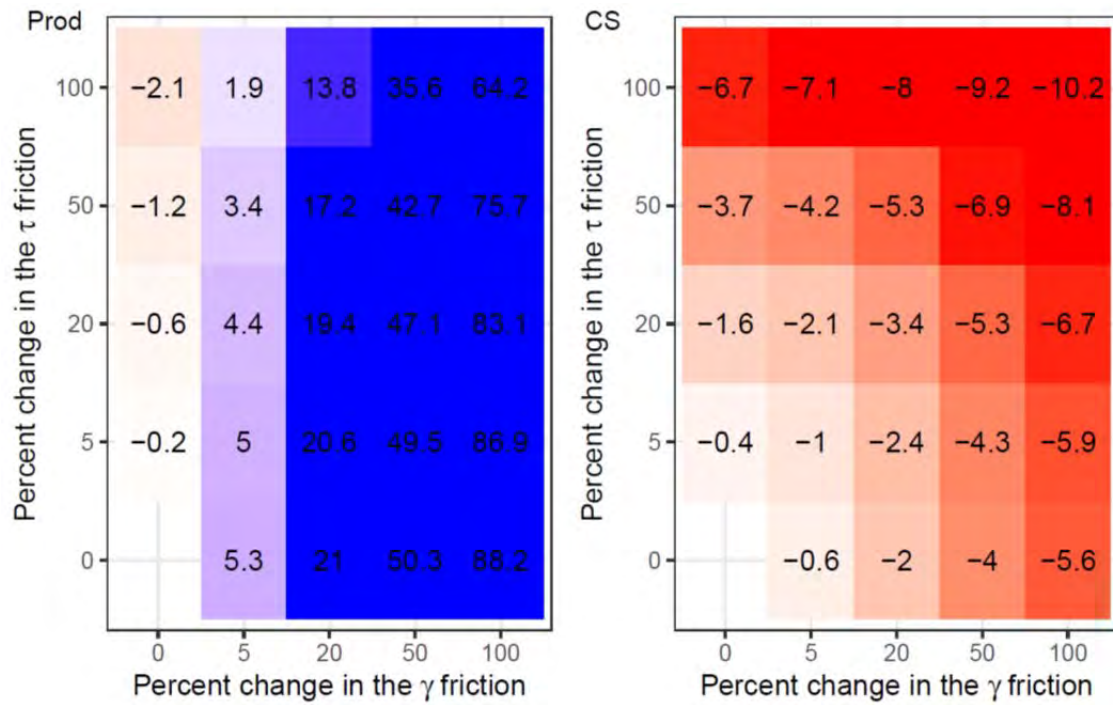

Source: Simulation by authors, IHS Markit.

4. The market-driven reevaluation of international trade and coordination costs
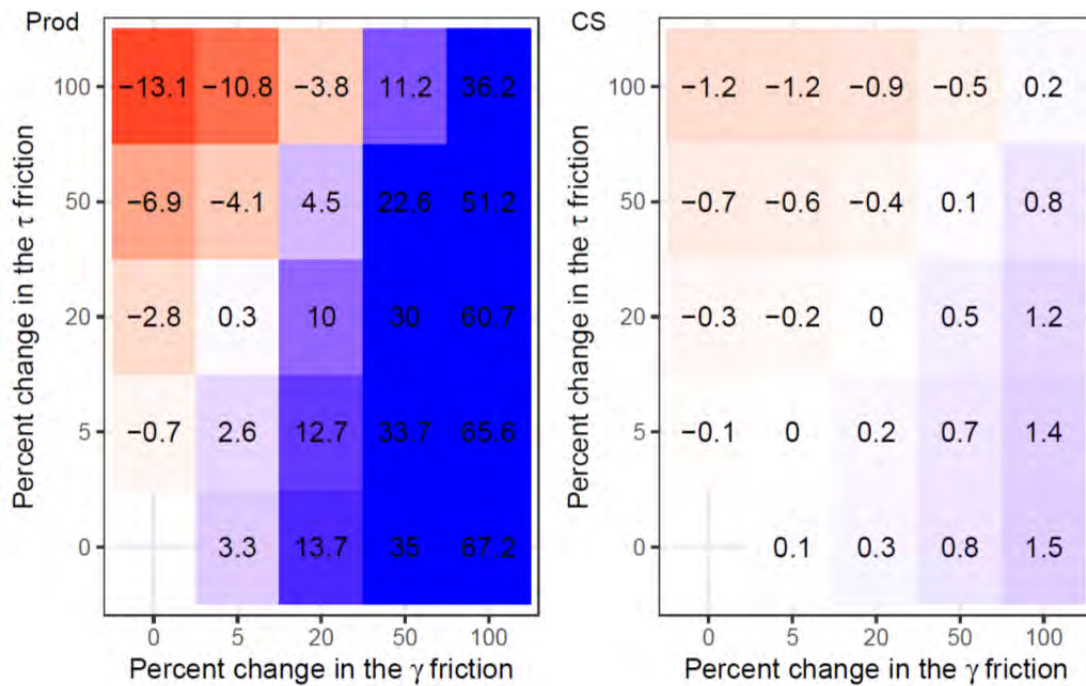
Figure 14. Change for FRA IRS = 1

Source: Simulation by authors, IHS Markit.
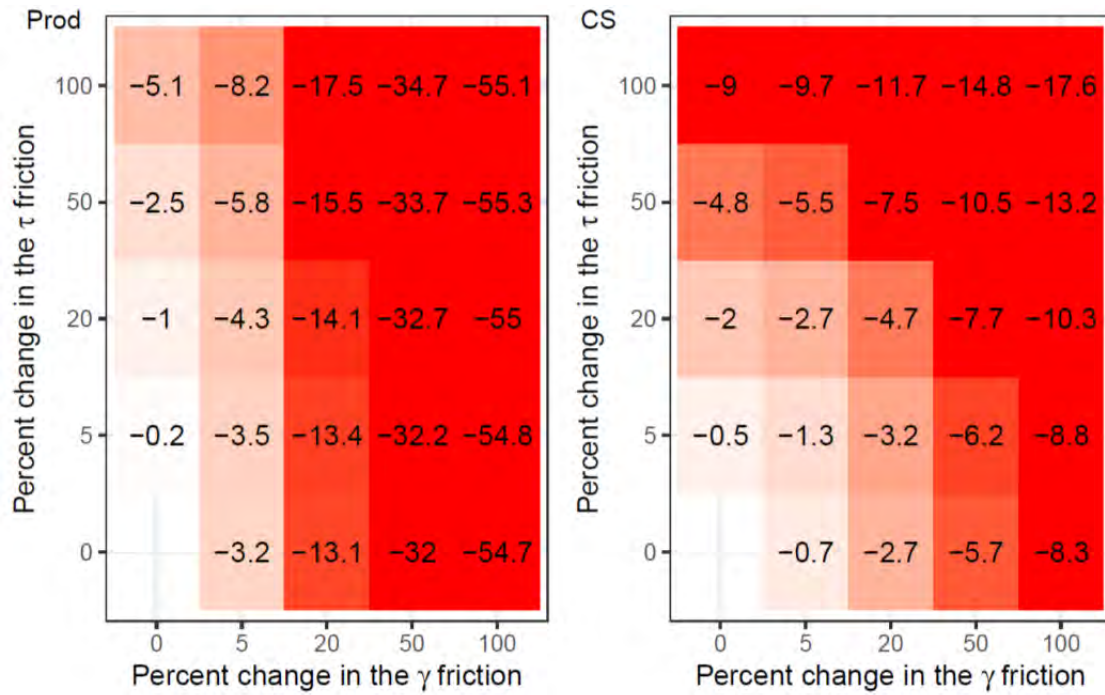
Figure 15. Change for DEU IRS = 1

Prod

Percent change in the τ friction ↓ / Percent change in the γ friction →	0	5	20	50	100
100	−2.1	1.9	13.8	35.6	64.2
50	−1.2	3.4	17.2	42.7	75.7
20	−0.6	4.4	19.4	47.1	83.1
5	−0.2	5	20.6	49.5	86.9
0		5.3	21	50.3	88.2

CS

Percent change in the τ friction ↓ / Percent change in the γ friction →	0	5	20	50	100
100	−6.7	−7.1	−8	−9.2	−10.2
50	−3.7	−4.2	−5.3	−6.9	−8.1
20	−1.6	−2.1	−3.4	−5.3	−6.7
5	−0.4	−1	−2.4	−4.3	−5.9
0		−0.6	−2	−4	−5.6

Source: Simulation by authors, IHS Markit.

Figure 16. Change for JPN IRS = 1

Prod

Percent change in the τ friction ↓ / Percent change in the γ friction →	0	5	20	50	100
100	−13.1	−10.8	−3.8	11.2	36.2
50	−6.9	−4.1	4.5	22.6	51.2
20	−2.8	0.3	10	30	60.7
5	−0.7	2.6	12.7	33.7	65.6
0		3.3	13.7	35	67.2

CS

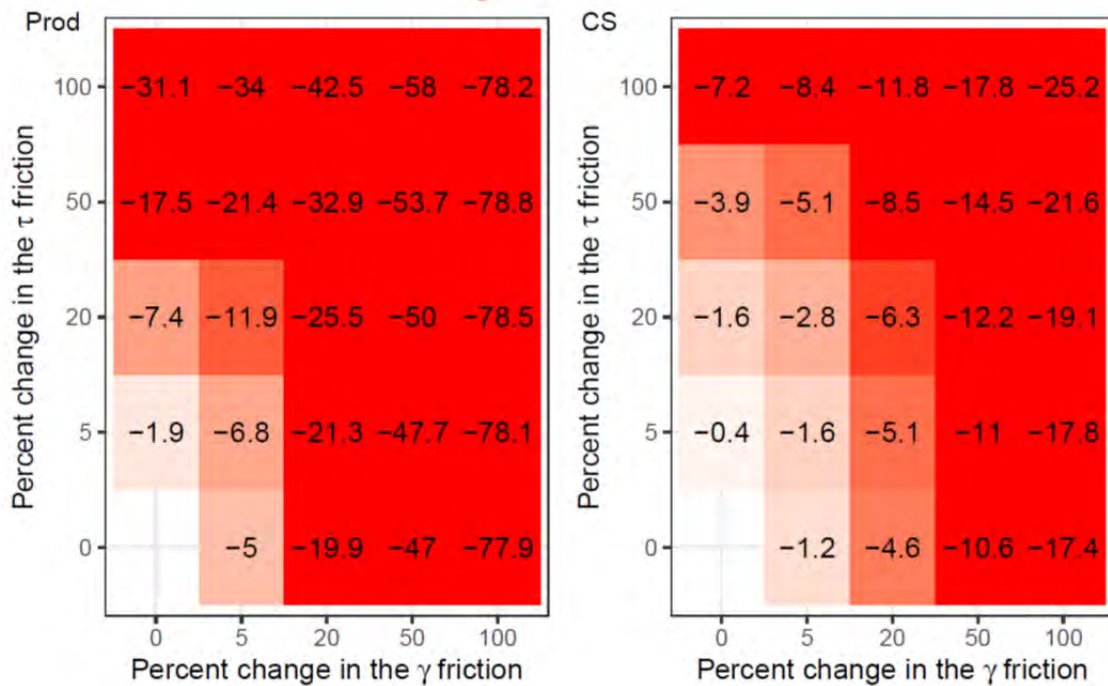| Percent change in the τ friction ↓ / Percent change in the γ friction →	0	5	20	50	100
100	−1.2	−1.2	−0.9	−0.5	0.2
50	−0.7	−0.6	−0.4	0.1	0.8
20	−0.3	−0.2	0	0.5	1.2
5	−0.1	0	0.2	0.7	1.4
0		0.1	0.3	0.8	1.5

Source: Simulation by authors, IHS Markit.

Figure 17. Change for ESP IRS = 1
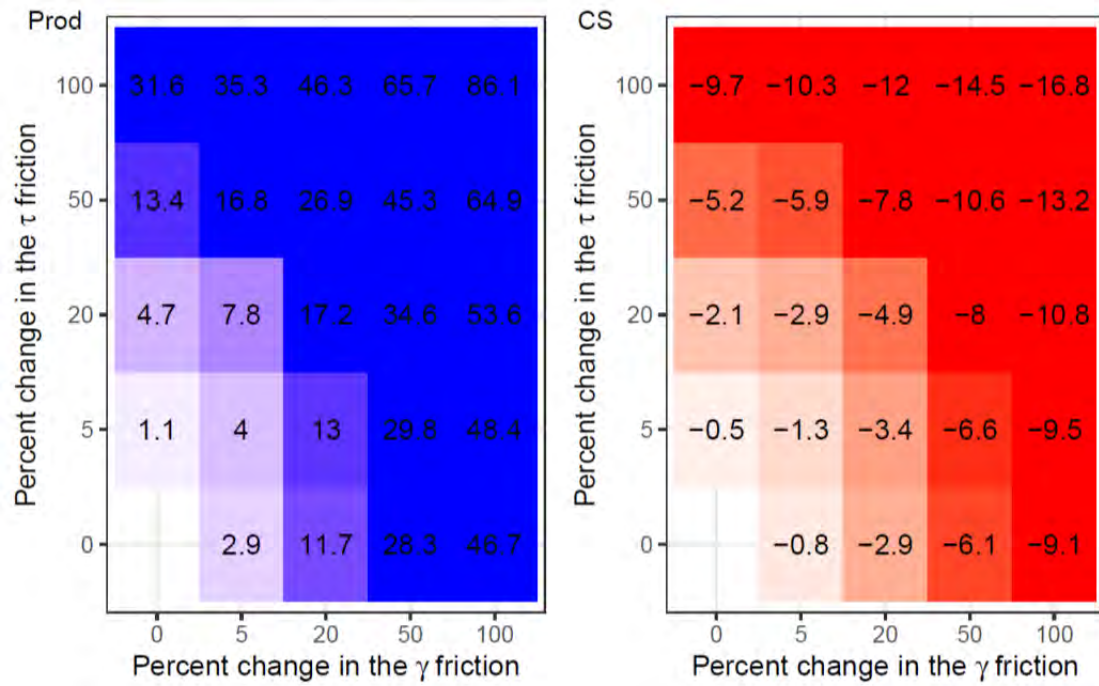

Source: Simulation by authors, IHS Markit.
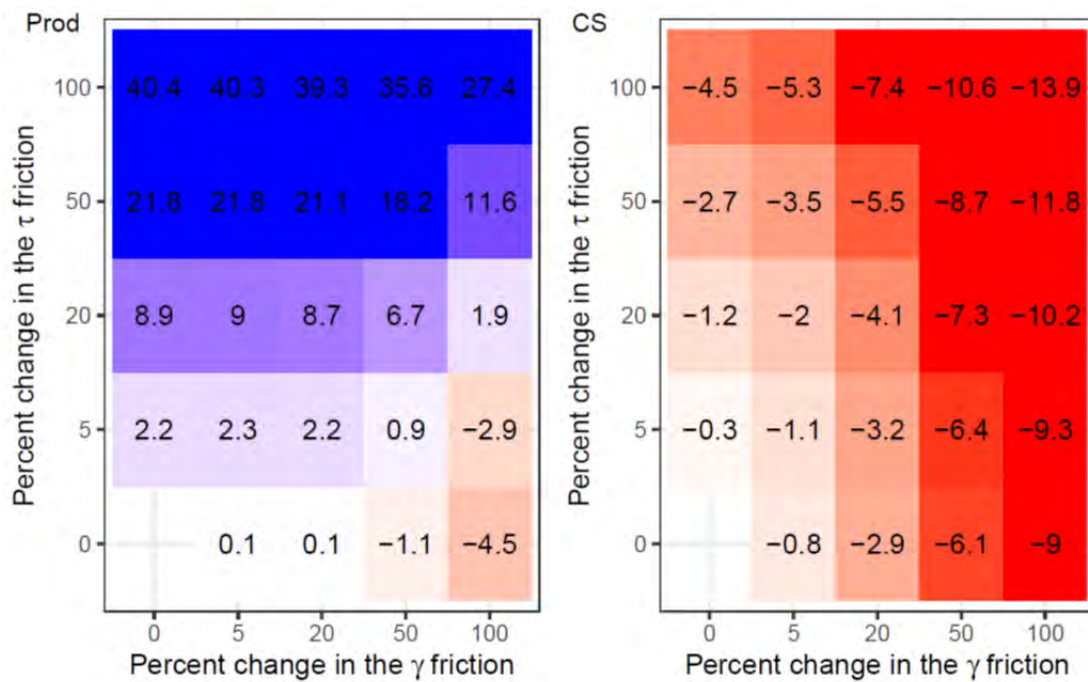
Figure 18. Change for MEX IRS = 1

Source: Simulation by authors, IHS Markit.
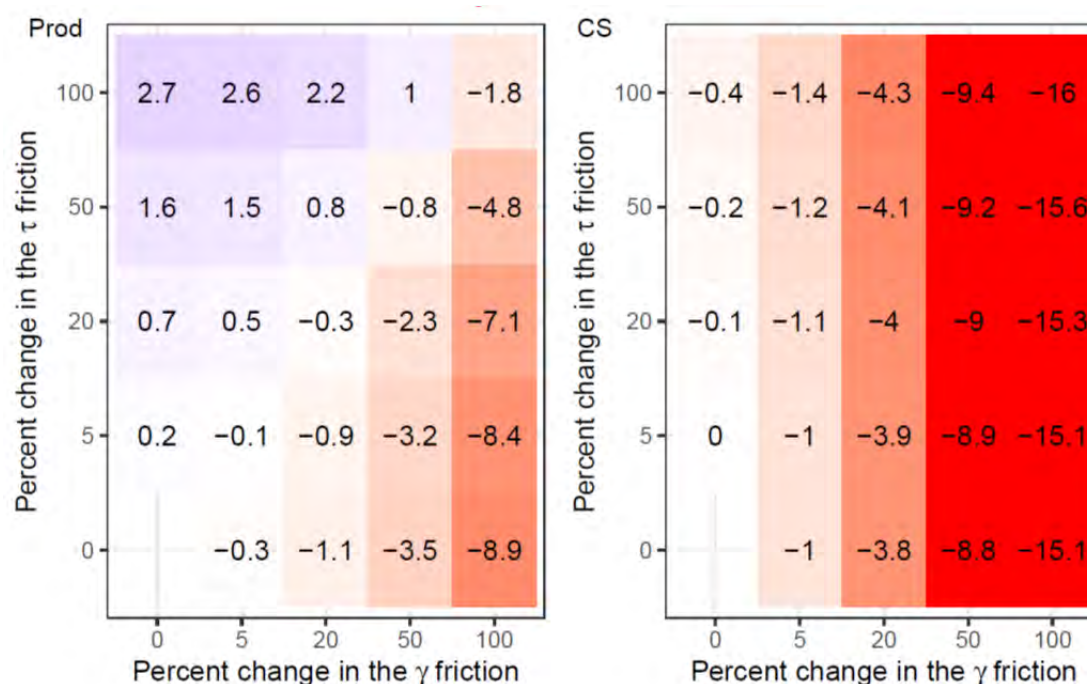
Figure 19. Change for ITA IRS = 1

Source: Simulation by authors, IHS Markit.

Figure 20. Change for USA IRS = 1

Source: Simulation by authors, IHS Markit.

Figure 21. Change for CHN IRS = 1

Source: Simulation by authors, IHS Markit.

So far, the scenarios envisioned (trade wars and trade agreements) focused on changes in the trade costs. However, as the recent Covid-19 crisis as shown, the cost for a firm to operate a production plant from abroad can also be subject to important frictions. For that reason, it is important to look at the sensitivity of production to both trade costs and multinational/coordination costs frictions.

The increase in tau means an increase in trade costs (transports, tariffs…). Therefore, importing becomes more expensive relative to domestic production. The increase in gamma means an increase in the coordination cost between the headquarter and the factories abroad. Therefore, an increase in gamma means that production becomes more expensive in countries that are not the country of the headquarter of the brand. These two increases will therefore have different consequences for each country.

We can notice four different groups of countries regarding the effect on production of such scenarios:
- France and Italy gain in terms of production after an increase in either tau or gamma
  – Explained by the fact that they have headquarters and existing factories and do not massively export
- Japan and Germany lose after an increase in tau but gain following an increase in gamma
  – These two countries however gain enough thanks to the increase in gamma to rapidly compensate for the loss incurred for an increase in tau
  – The gain in gamma is explained by the presence of headquarters in these countries and the loss in tau by the fact that these countries are important exporters
- For the USA it is the opposite: they lose production from the increase in gamma and gain from the increase in tau
  – Explained by relatively few exports and few headquarters with factory abroad
  – China interesting sub-case: quasi autarchic but loses to gamma because some factories located in China have headquarters abroad
- Spain (+ Mexico) lose on both
  – Large exports and few (or none for Mexico) brand headquarters

Regarding the consumer surplus:

- The increase in either tau or gamma means an increase in prices for all countries, except Japan
  - Japan indeed has a large "home-made consumption" (92% in 2018) and a lot of headquarters, therefore relocation increases the economies of scale, decreasing prices. This decrease in prices, is not compensated by the increase in the price of imported cars.

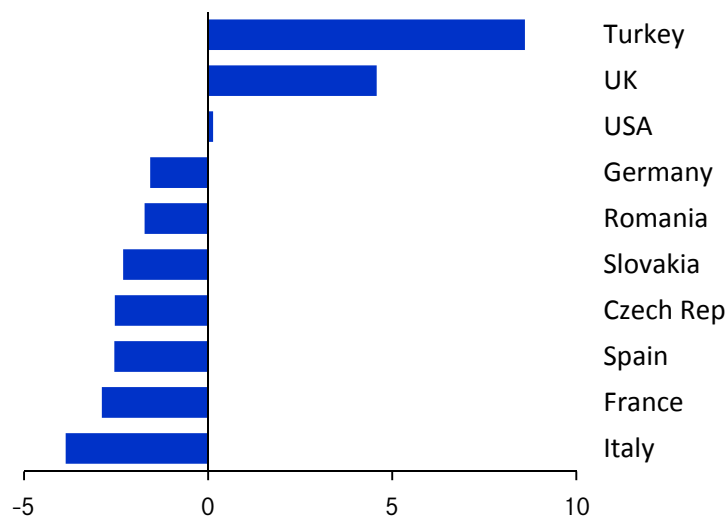# 5. Extension of the ETS system to the Automobile industry

We simulate an extension of the ETS to the automotive sector. Our counterfactual scenario considers a price of 40€ per ton of CO_2 in the production process. This approximately corresponds to a 2% increase in costs for EU-based plants.

This increase in cost has a direct impact: reduces the attractiveness of EU producing countries while it increases attractiveness of EU bordering countries such as Turkey. It would for instance generate a 3% decrease of French production.

In the model, an EU-border carbon adjustment mechanism on car imports of 2% is an exactly symmetrical tax as the extension of the ETS. Therefore, imposing simultaneously the extension of the ETS and the EU border tax would have a null effect on production.

It is however important to note that these scenarios will impact the consumer surplus. Indeed, in both cases, the measures will result into an increase in prices for consumers and this increase in price does not cancel out when the two are implemented simultaneously.

Figure 22. Effect of an extension of the ETS on production (+ 2%, i.e. 40 € per ton)

Source: Simulation by authors, IHS Markit.

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